

Serial No. : 10/771,812  
Filed : February 4, 2004

IN THE SPECIFICATION:

(1) The paragraph [0023] from page 9, line 20 to page 10, line 11 has been amended as follows:

In the non-rotary cutting tool defined in the sixth aspect of the invention, the side cutting edge portion of the cutting edge has the high degree of parallelism with respect to the axis of the cylindrical shank portion such that the error in the parallelism is not larger than 3  $\mu\text{m}$ , while the end cutting edge portion of the cutting edge has the high degree of perpendicularity with respect to the axis of the cylindrical shank portion such that the error in the perpendicularity is not larger than 3  $\mu\text{m}$ . In other words, the side cutting edge portion is not deviated, by an amount larger than 3  $\mu\text{m}$ , from a geometrical straight line which is precisely parallel with the axis of the cylindrical shank portion, while the end cutting edge portion is not deviated, by an amount larger than 3  $\mu\text{m}$ , from a geometrical straight line which is precisely perpendicular to the axis of the cylindrical shank portion. Such a minimum error in the contour of the cutting tool is advantageous, especially, where the cutting tool is used for finishing a workpiece, such as the scroll member of the scroll compressor, which requires to be finished with a high degree of machining accuracy.

(2) The paragraph [0024] from page 10, line 13 to page 11, line 19 has been amended as follows:

Serial No. : 10/771,812  
Filed : February 4, 2004

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of the presently preferred embodiments of the invention, when considered in connection with the accompanying drawings, in which:

Fig.1 is a set of three views of a non-rotary cutting tool which is constructed according to a first embodiment of the invention, wherein a front view, a side view and a bottom view of the cutting tool are given at ~~(a), (b) and (c)~~ (c), (b) and (a), respectively;

Fig. 2 is a table indicating specifications of the non-rotary cutting tool and an end mill used in a cutting test, and cutting conditions in the cutting test;

Fig. 3 is a table indicating a result of the cutting test;

Fig. 4A is a front view of a non-rotary cutting tool which is constructed according to a second embodiment of the invention;

Fig. 4B is a front view of a non-rotary cutting tool which is constructed according to a third embodiment of the invention;

Fig. 5A is a perspective view of a fixed scroll member as a product machined by the non-rotary cutting tool of the invention;

Serial No. : 10/771,812  
Filed : February 4, 2004

Fig. 5B is a perspective view of an orbiting scroll member as a product machined by the non-rotary cutting tool of the invention;

Fig. 6 is a set of views showing an operation of a scroll compressor which is constituted by the fixed scroll member and the orbiting scroll member; and

Fig. 7 is a view illustrating a machining operation in which the scroll member of the scroll compressor is machined by the non-rotary cutting tool of the invention.

(3) The paragraph [0025] from page 11, line 22 to page 12, line 7 has been amended as follows:

Referring first to Fig. 1, there will be described a non-rotary cutting tool 1 which is constructed according to a first embodiment of the invention. Fig.1 is a set of three views of the non-rotary cutting tool 1, wherein its front view, side view and bottom view are given at ~~(a), (b) and (c)~~ (c), (b) and (a), respectively. The non-rotary cutting tool 1 is a so-called "gooseneck tool", and is to be held at its end portion (right end portion as seen at (a), (b) of Fig. 1) by a suitable tool holder (not shown) so that the cutting tool 1 is fixed to a spindle of a machine tool (not shown) such as a machining center through the suitable tool holder. This non-rotary cutting tool 1 is advantageously used, for example, in a finishing step of a process of machining a scroll compressor, as shown in Fig. 7.

Serial No. : 10/771,812  
Filed : February 4, 2004

(4) The paragraph [0026] from page 12, line 8 to page 12, line 20 has been amended as follows:

The non-rotary cutting tool 1 is provided by a substrate (single piece) formed of a cemented carbide which is made from, for example, tungsten carbide (WC) in a powder-metallurgy process including compacting and sintering steps. The cutting tool 1 includes a generally semi-cylindrical body portion 2 which has a generally semi-circular cross sectional shape (as shown at (c) of Fig. 1), and a generally cylindrical shank portion 3 which is coaxially contiguous to a proximal end portion of the semi-cylindrical body portion 2 (i.e., right end portion of the body portion 2 as seen at (a), (b) of Fig. 1). Preferably, the generally semi-cylindrical body portion 2 has a half-moon shape in cross section as shown in (c) of Fig. 1. The cutting tool 1 is held at the shank portion 3 by the tool holder, so that the cutting tool 1 is attached to a machine tool through the tool holder.

(5) The paragraph [0027] from page 12, line 21 to page 13, line 15 has been amended as follows:

The semi-cylindrical body portion 2, serving as a cutting blade portion, has a rake face 8 consisting of a flat surface which lies substantially on an axis of the cylindrical shank portion 3, and a cutting edge 4 which is defined by an edge of the rake face 8. The semi-cylindrical body portion 2 has an outer circumferential surface constituted by the rake face 8

Serial No. : 10/771,812  
Filed : February 4, 2004

and a semi-cylindrical surface. The rake face 8, provided by the flat surface, is elongated in an axial direction of the semi-cylindrical body portion 2, and has a width smaller than a diameter A of the cylindrical shank portion 3. Further, a thickness C of the rake face 8 is a half of a diameter B of the tapered end of the cylindrical shank portion 3 since the semi-cylindrical body portion 2 has the half-moon shape in cross section as shown in Figs. 1(b) and 1(c). The cutting edge 4 includes a side cutting edge portion 5 located at each of widthwise opposite ends of the rake face 8, and an end cutting edge portion 6 located at an axially distal end of the rake face 8. In other words, the side cutting edge portion 5 is provided by an intersection of the rake face 8 and the semi-cylindrical surface, while the end cutting edge portion 6 is provided by an intersection of the rake face 8 and an axially distal end face of the semi-cylindrical body portion 2. The side cutting edge portion 5 and the end cutting edge portion 6 intersect substantially perpendicularly with each other, as shown at (a) of Fig. 1. A nose or corner at which the side and end cutting edge portions 5, 6 intersect with each other is so sharp to have a nose radius of not larger than 0.05 mm.

(6) The paragraph [0032] from page 15, line 4 to page 15, line 22 has been amended as follows:

Serial No. : 10/771,812  
Filed : February 4, 2004

In a machining operation with the non-rotary cutting tool 1 constructed as described above, the cutting tool 1 is moved relative to a workpiece in a predetermined direction, while being kept unrotated and maintaining such a posture that permits the rake face 8 to be held substantially perpendicular to the predetermined direction, so that the workpiece is cut by the side and end cutting edge portions 5, 6 of the cutting edge 4. In other words, since the rake face 8 is perpendicular to the relative moving direction, a rake angle of the rake face 8 of the cutting tool 1 is 0°. Fig. 7 is a view illustrating a machining operation in which the scroll member of the scroll compressor is machined by the non-rotary cutting tool 1. In this machining operation performed in a machining center equipped with a rotary table that is rotatable about A axis, the scroll member mounted on the rotary table is controlled to be moved relative to the cutting tool 1 (attached to a spindle of the machining center) in at least one of X-axis and Y-axis directions at a predetermined feed rate, while being rotated about A axis at a predetermined angular velocity, so that the scroll wall 105 and the base plate 104 are machined by the side cutting edge portion 5 and the end cutting edge portion 6 of the cutting edge 4, respectively.

(7) The paragraph [0038] from page 18, line 7 to page 18, line 24 has been amended as follows:

Serial No. : 10/771,812  
Filed : February 4, 2004

Where the non-rotary cutting tool 1 is used for machining each of the scroll members 100, 103 of the scroll compressor, at least one of the cutting tool 1 and the scroll member is moved relative to the other or each other in a predetermined direction, while the rake face 8 of the cutting tool 1 is held substantially perpendicular to the predetermined direction, so that the scroll wall and the base plate are machined by the side and end cutting edge portions 5, 6, respectively. As noted above, since the rake face 8 is perpendicular to the relative moving direction, the rake angle of the rake face 8 is 0° when cutting the scroll members 100, 103. Since the cutting tool 1 is not rotated in the machining operation, the machined scroll member is free from deterioration in its accuracy which could be caused by "run out" of the cutting tool of the conventional type such as an end mill. That is, the pair of scroll members 100, 103 can be machined with a higher degree of accuracy than where it is machined by a rotary cutting tool such as an end mill which is likely to suffer from its run out, so that it is possible to obtain a higher degree of fluid tightness between scroll walls 102, 105 of the respective scroll members 100, 103 and accordingly a higher degree of compression efficiency in the scroll compressor.